Arctic Sea Ice Biota

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Arctic Biodiversity Congress, Trondheim, 2-4 December

Sea Ice Biota Expert Network (SIB EN)

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Canada:

Michel Poulin (Canadian Museum of Nature, Ottawa)

Russia:

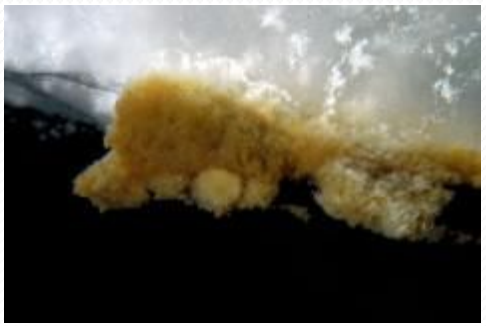
Igor Melnikov (Institute of Oceanology, Moscow)

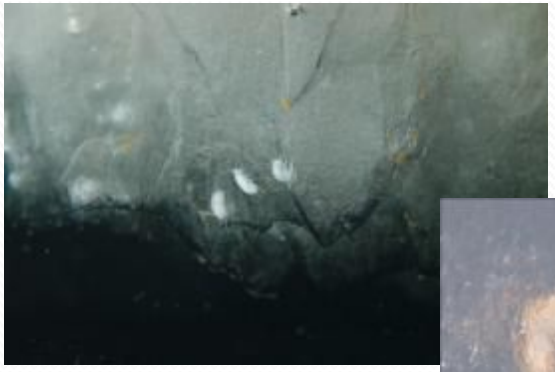
Greenland:

Thomas Juul Pedersen (Greenland Institute of Natural Resources)

Sea ice biota

- Microbes
- Ice algae
- Meiofauna
- Macrofauna
- Polar cod–> fish group deals with that





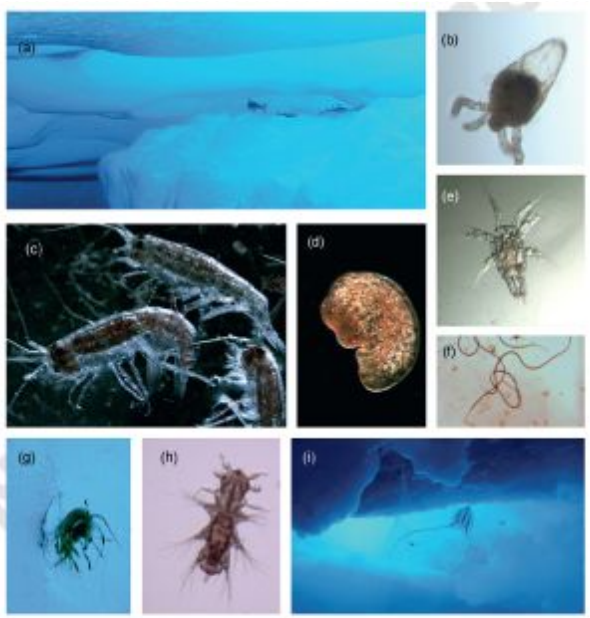
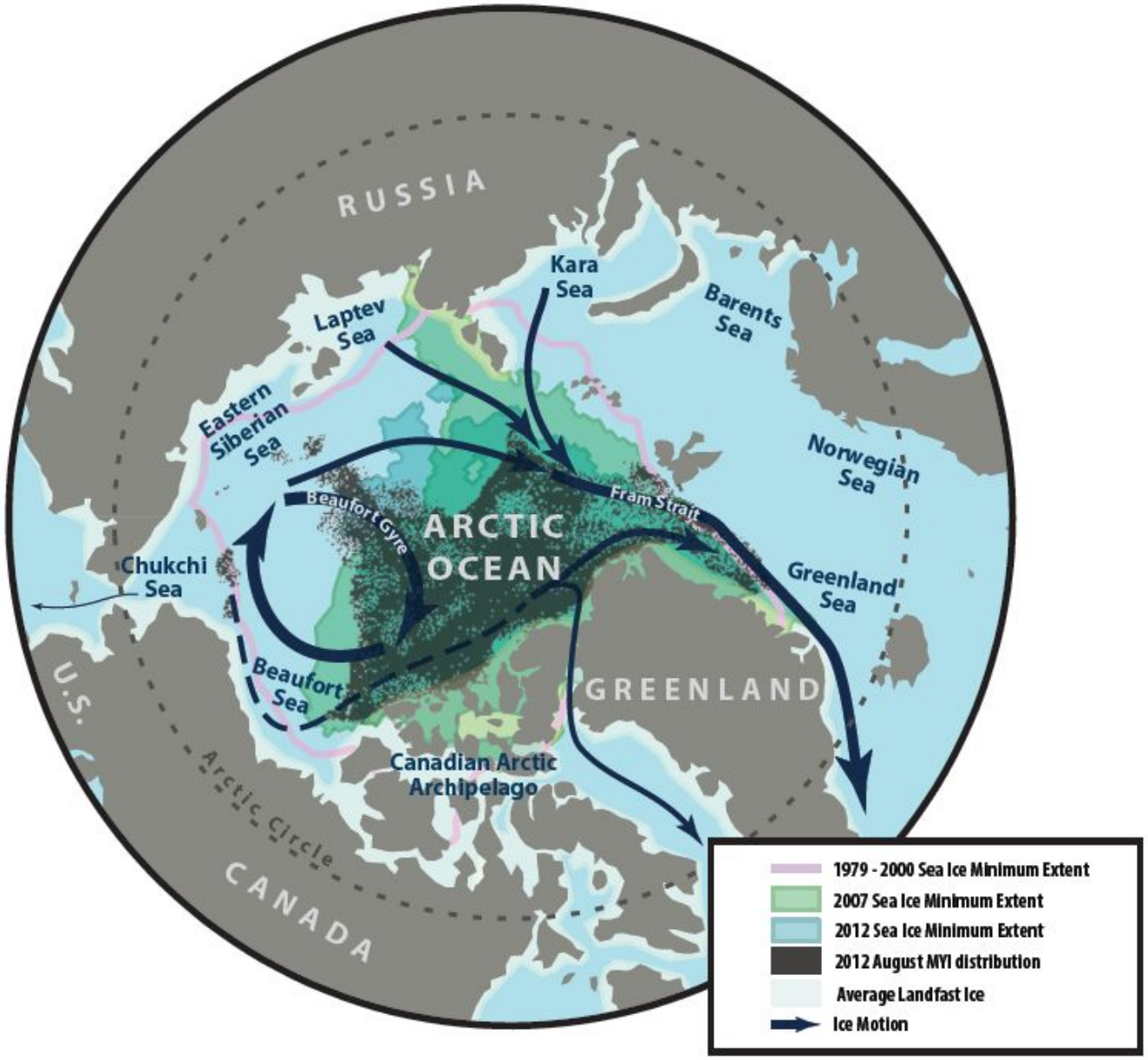
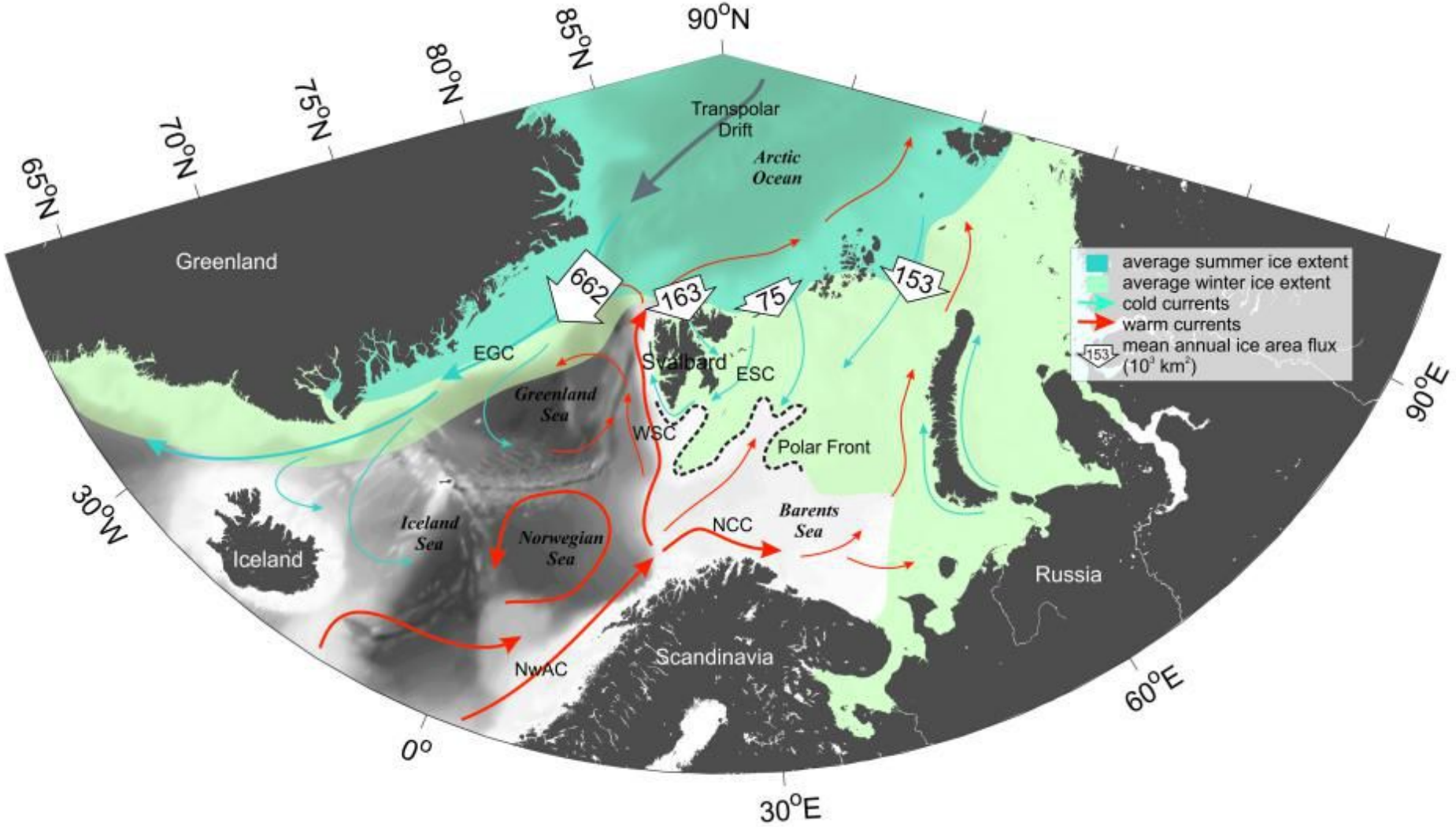
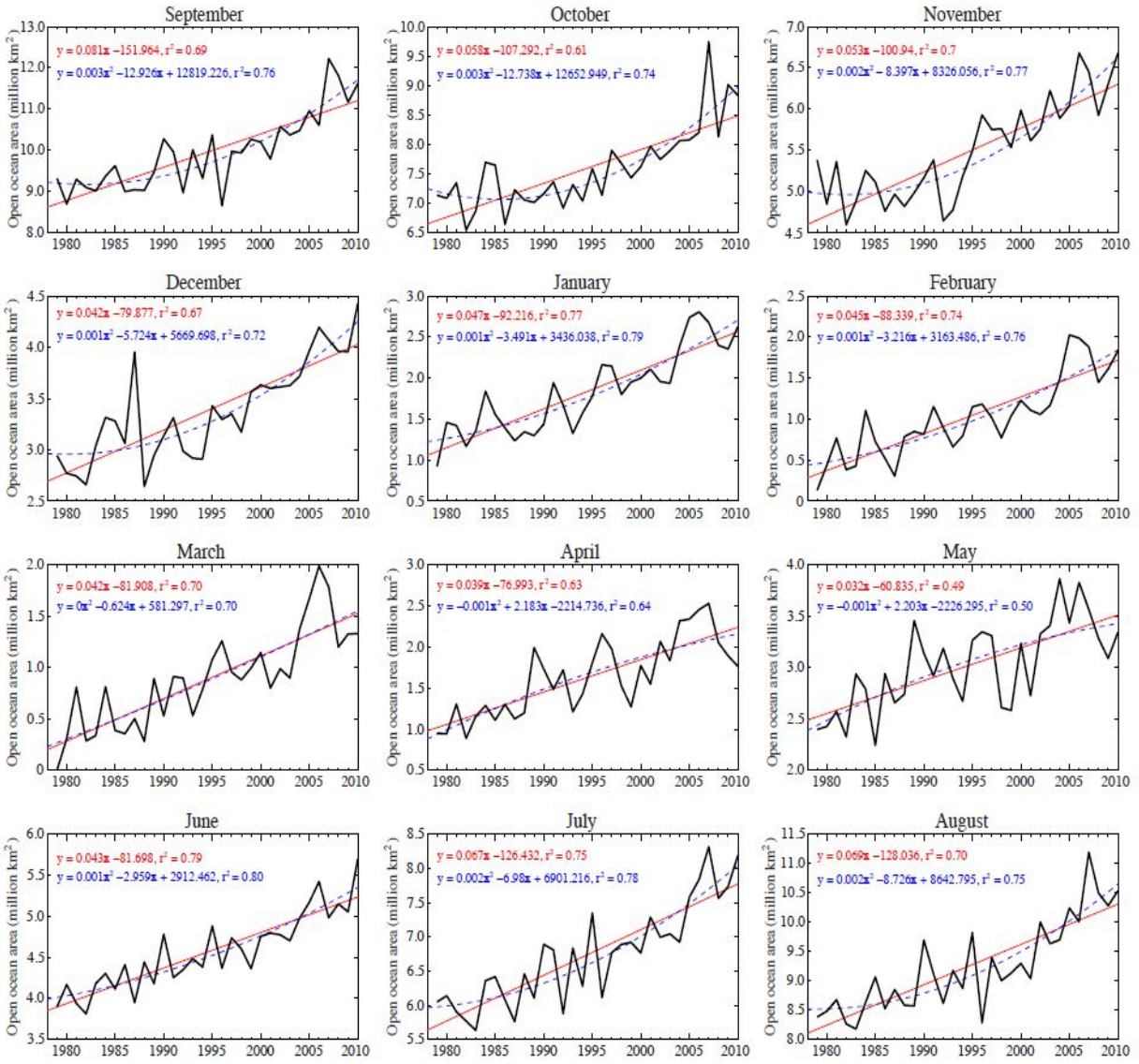


Fig. 10.1 Arctic ice-associated fauna. (a) Arctic cod, Boreogadus saida (about 15 cm), (b) Sympagohydra tuuli (350 µm), (c) Apherusa glacialis (18 mm), (d) turbellarian (500 µm), (e) Copepod nauplius (70 µm), (f) nematode (650 µm), (g) Gammarus wilkitzkii (3 cm), (h) Hesionidae juvenile (460 µm), (i) Mertensia sp. (several cm). Photographs by Bodil Bluhm (c–f, h), Rolf Gradinger (b), and Katrin Iken (a, i; all at University of Alaska Fairbanks). Photographs reproduced with permission from Katrin Iken.


RUSSIA
Kara Sea
Barents Sea
Laptev Sea
Eastern Siberian Sea
Norwegian Sea
Fram Strait
Beaufort Gyre
ARCTIC OCEAN
Chukchi Sea
Greenland Sea
Beaufort Sea
GREENLAND
U.S.
Arctic Circle
Canadian Arctic Archipelago
CANADA
1979 - 2000 Sea Ice Minimum Extent
2007 Sea Ice Minimum Extent
2012 Sea Ice Minimum Extent
2012 August MYI distribution
Average Landfast Ice
Ice Motion

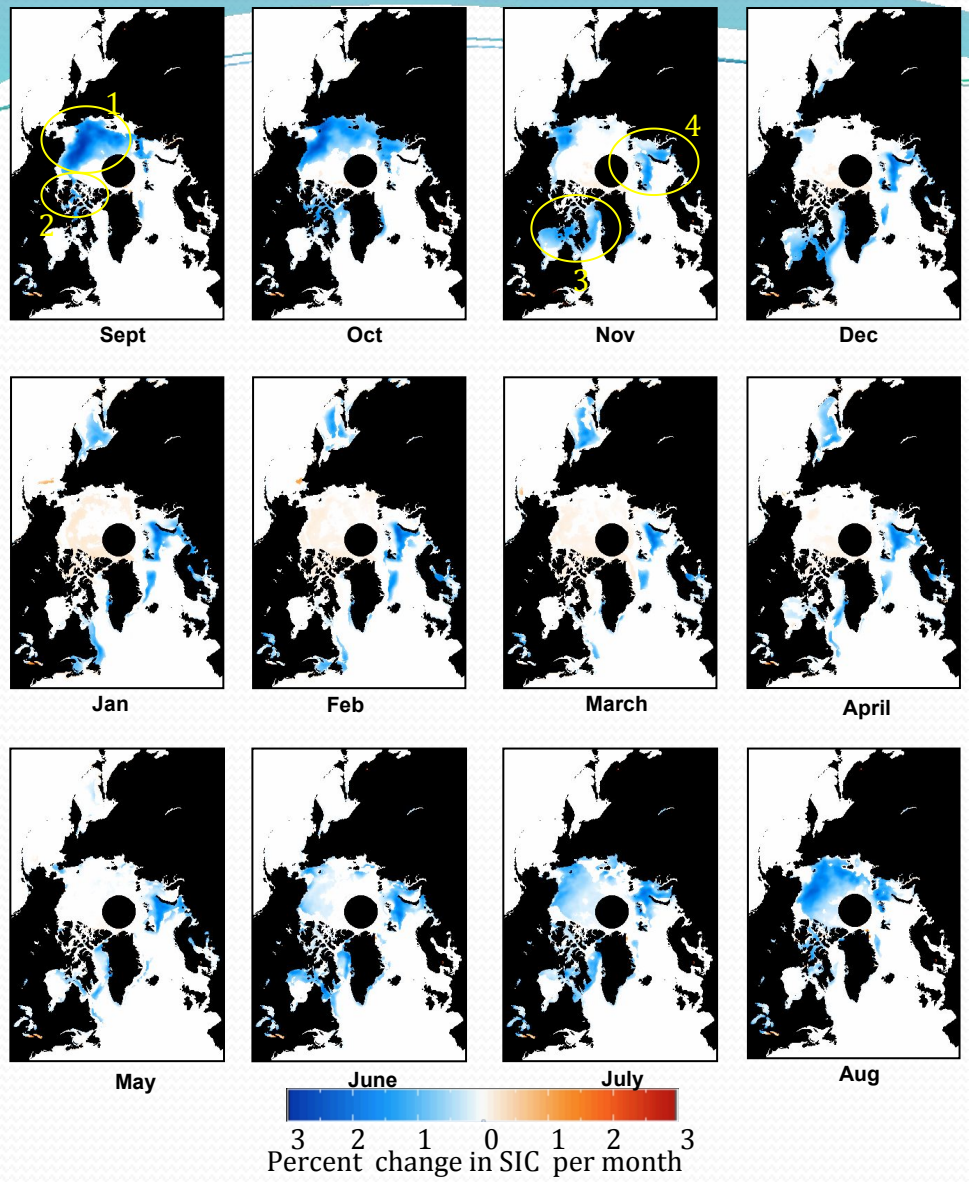


Hunt *et al.* (in prep.)



Open ocean area change expressed in 10^6 km^2 on average per month relative to March 1979.
All linear (red) and quadratic (blue) regressions are statistically significant, with $p<0.0001$.

Barber *et al.* in press



1) The Pacific Sector of the Arctic Ocean including the Canada Basin and the Beaufort, Chukchi and East Siberian seas

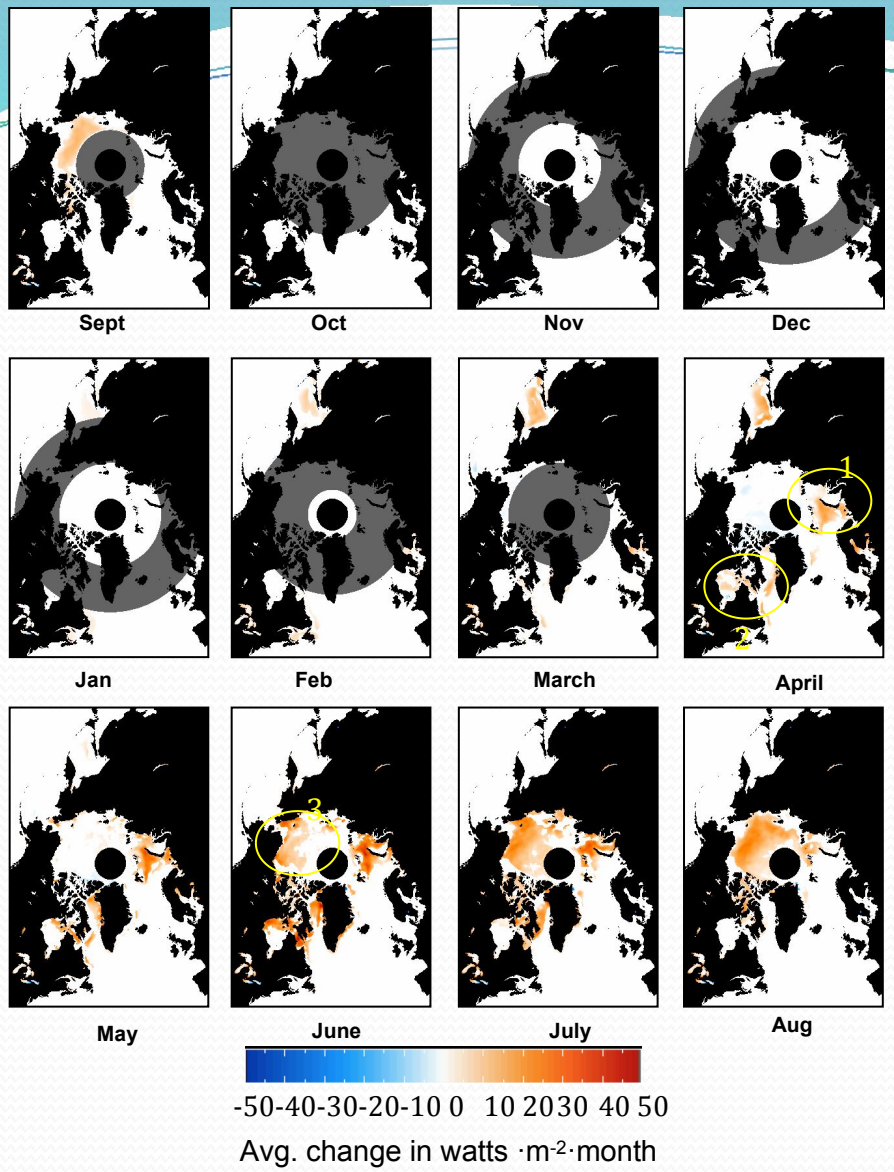
2) The Canadian Arctic Archipelago

3) Baffin Bay and Hudson Bay

4) Barents and Kara seas

Trends in open water (blue) and sea-ice concentration (red) showing where trends are located geographically around the Northern Hemisphere.

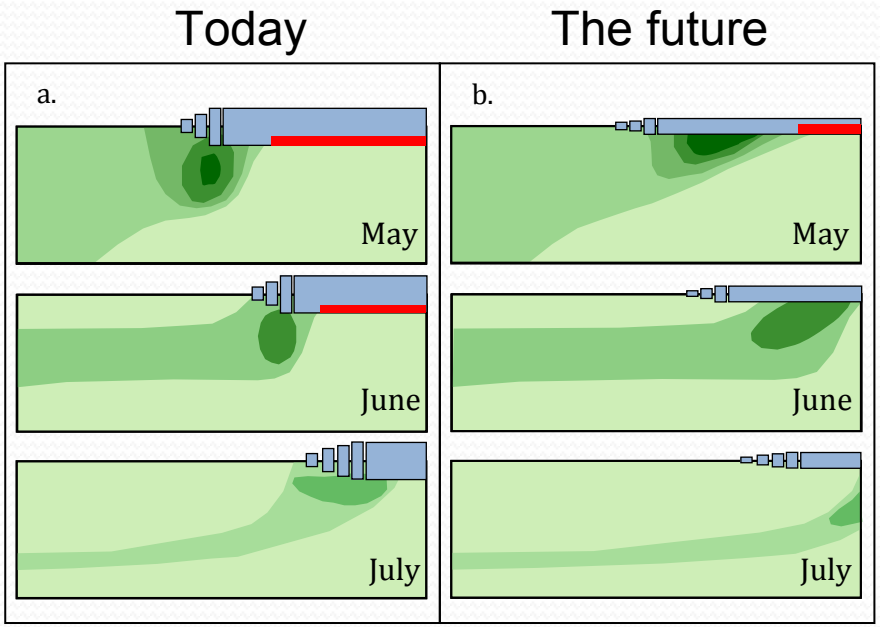
Barber *et al.* in press



Barber *et al.* in press

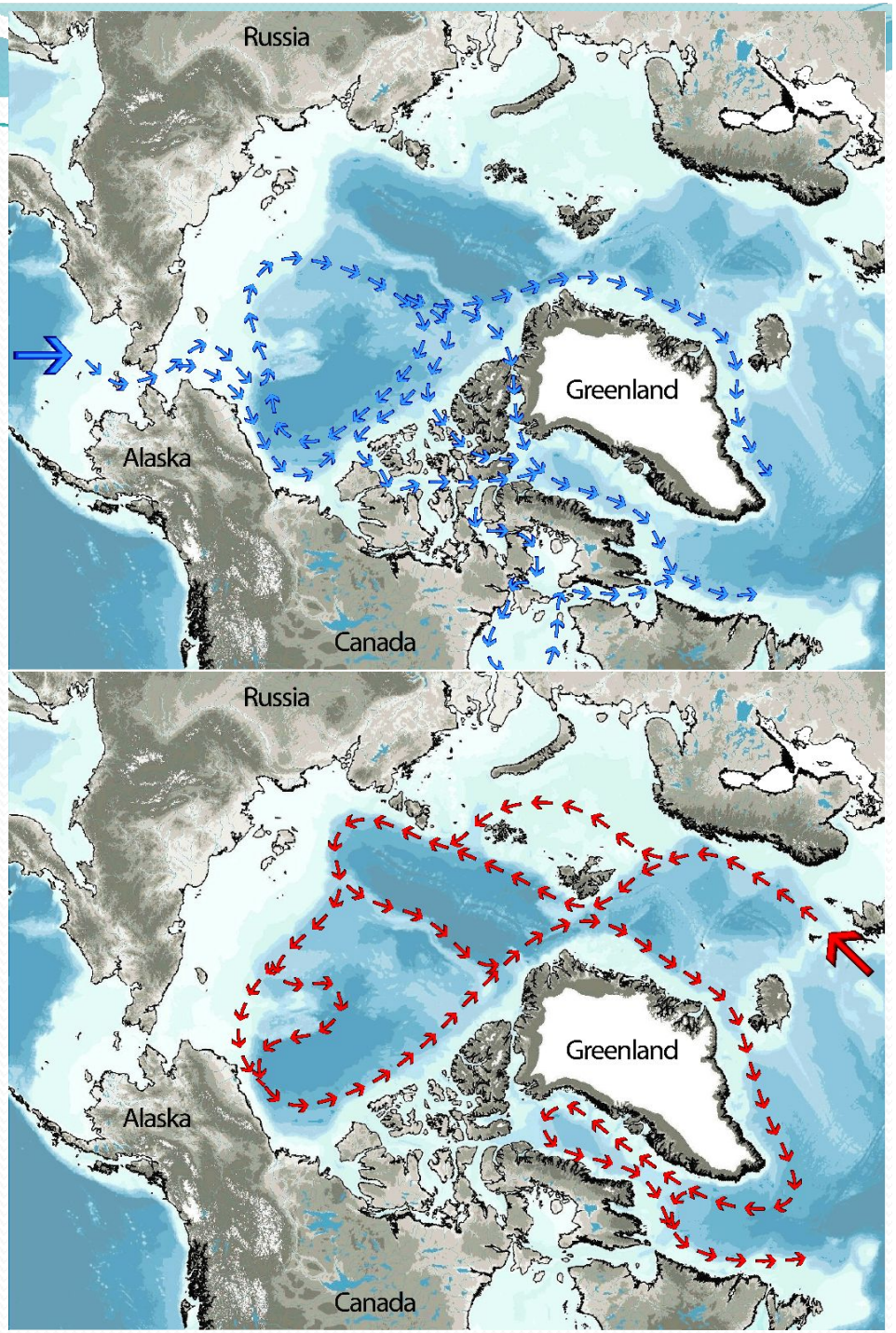
Trends in photosynthetically available radiation (PAR) based on the geographic distributions of ice and open water and earth's sun geometry by season.
Values represent the change in average total daily PAR per year by month.
The effect of clouds is not considered.

The grey ring around some of the grids is due to missing irradiance values caused by a solar zenith angle that was too large (> 80° measured from vertical) for irradiance calculations (i.e., Arctic winter).



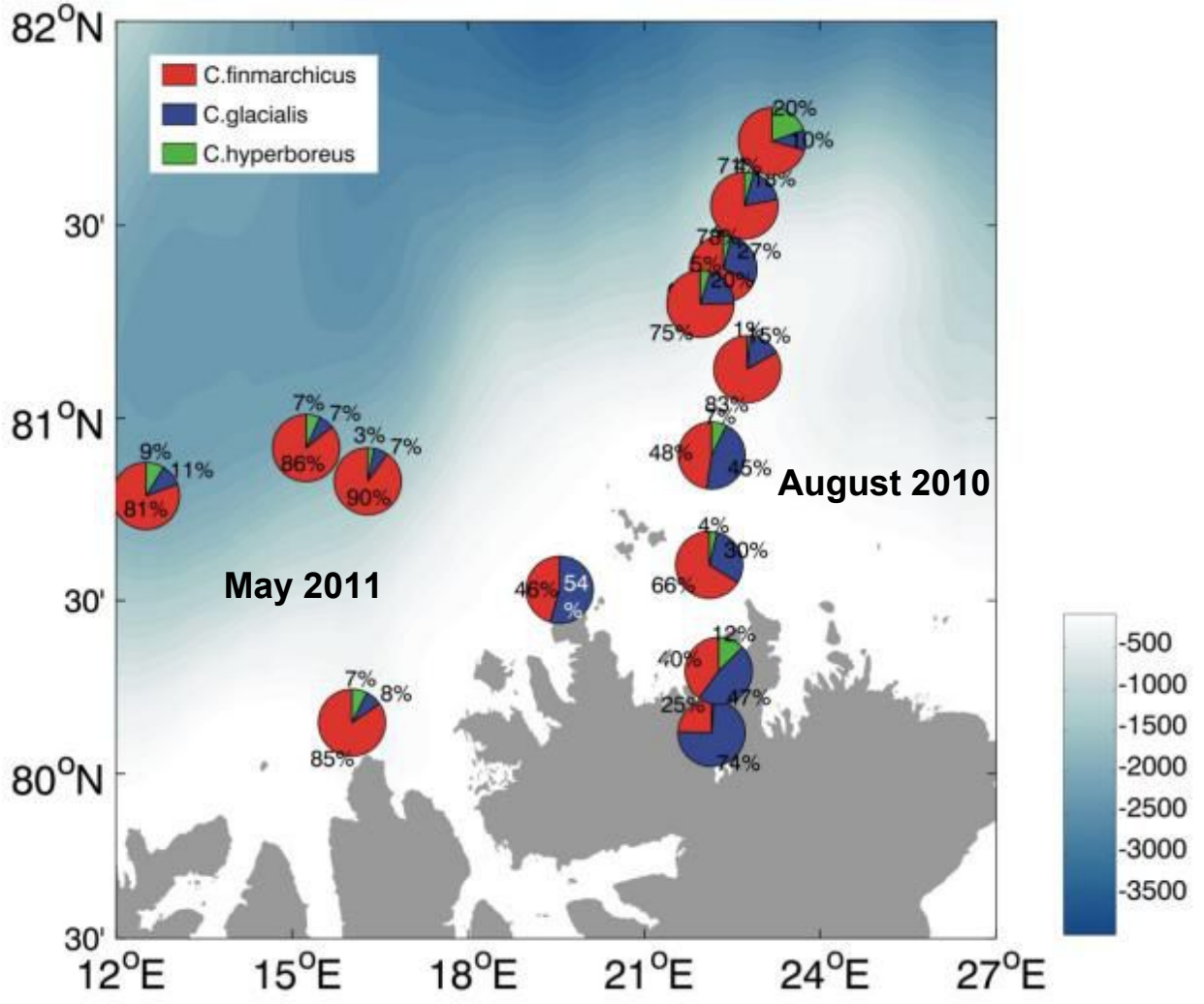
PACIFIC WATERS

ATLANTIC WATERS



E. Carmack, DFO

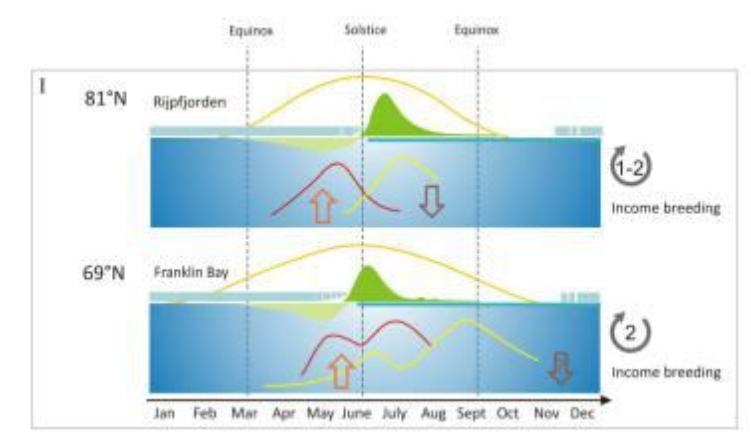
Calanus species composition August 2010 & May 2011



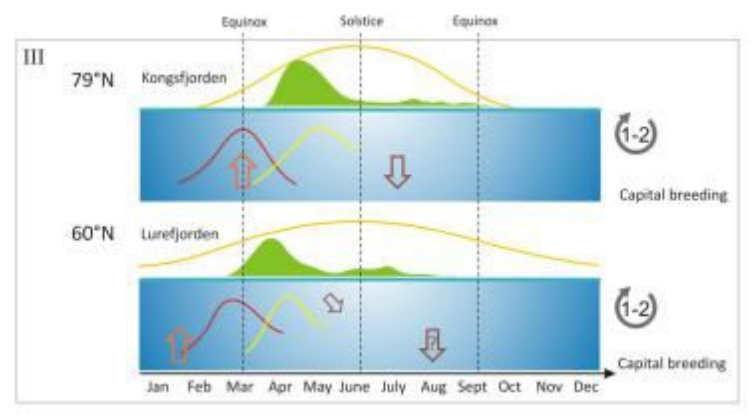
Advected zooplankton & timing

Calanus glacialis life history

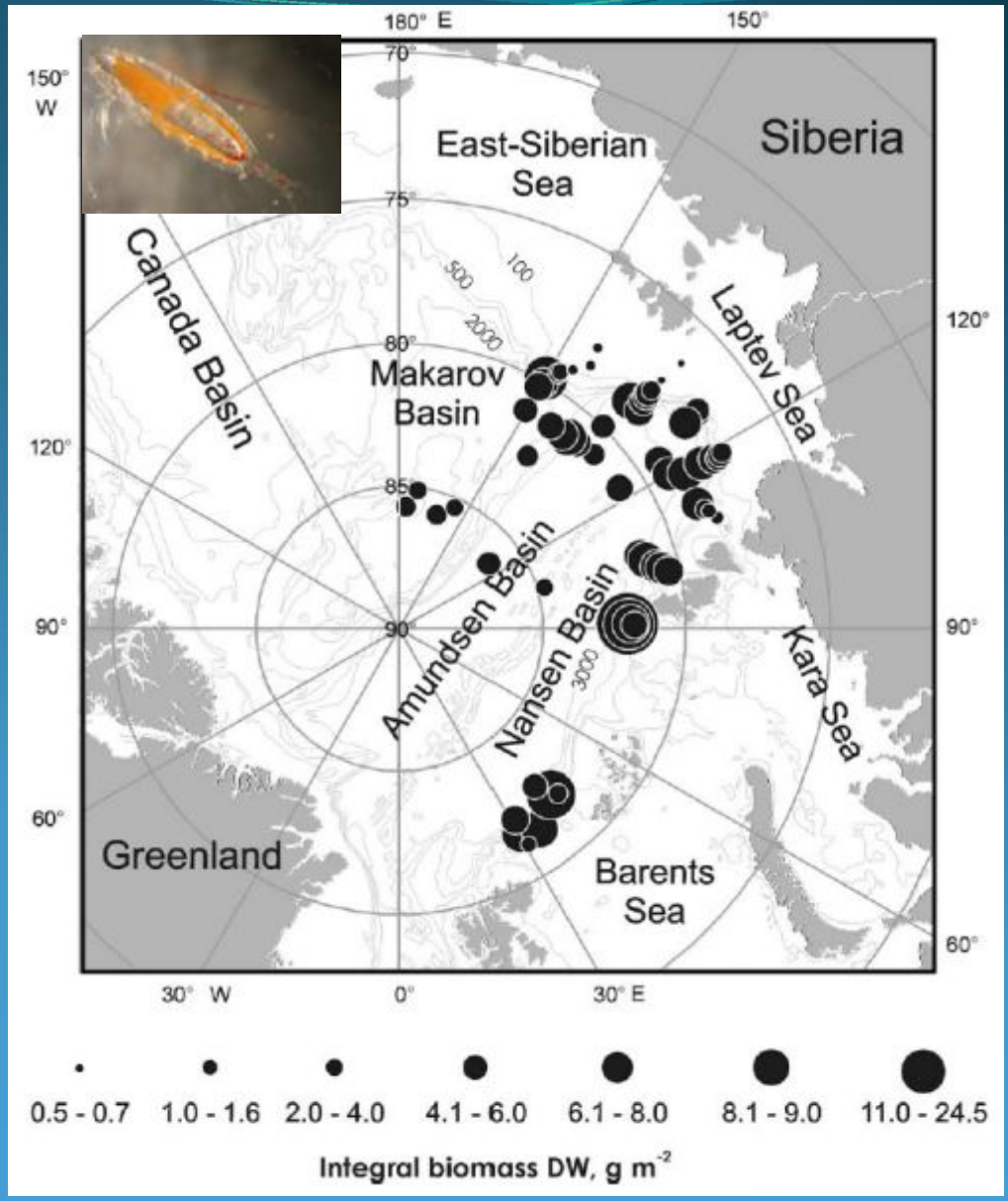
Stable seasonal ice, long-lasting



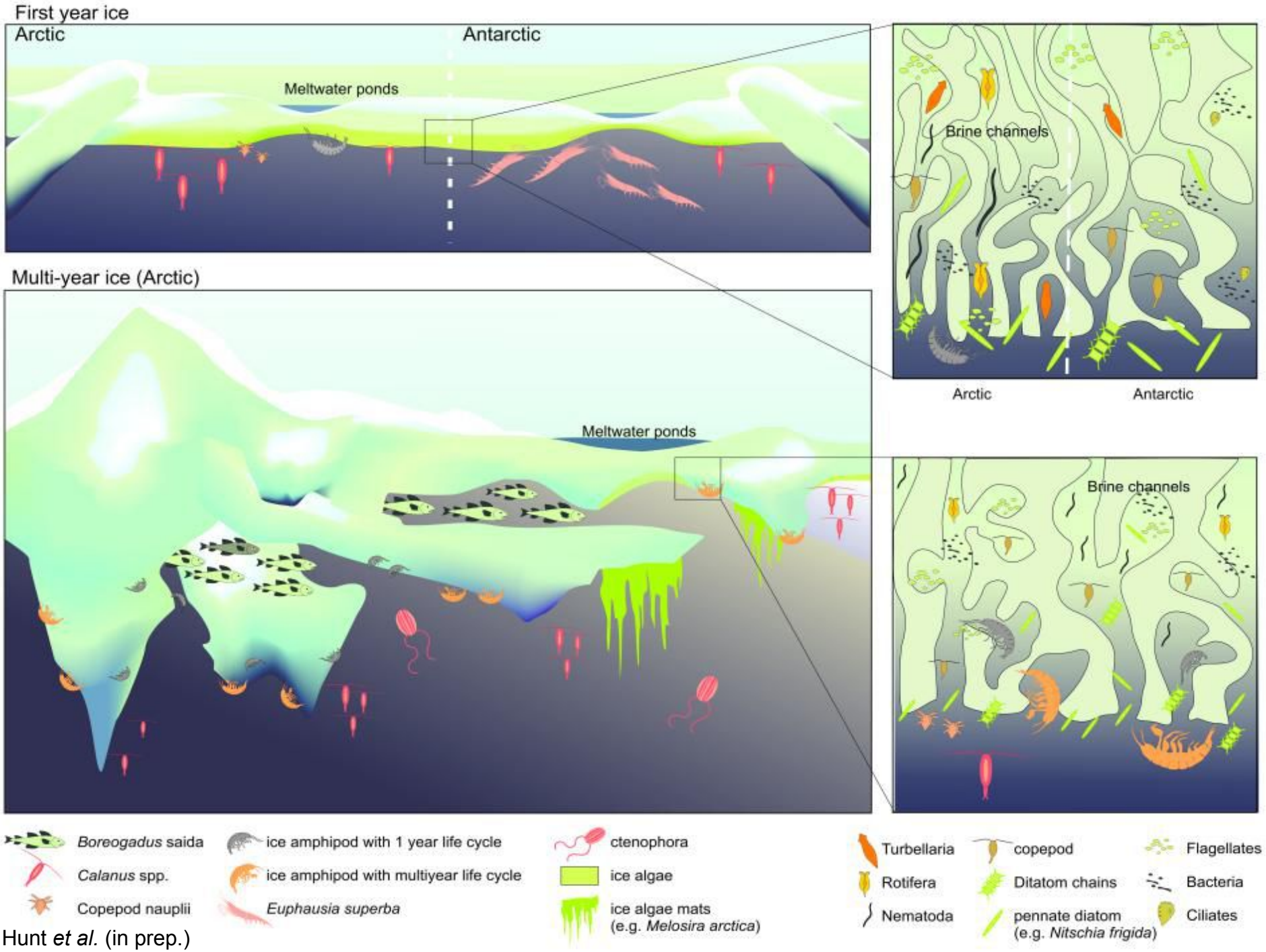
No ice



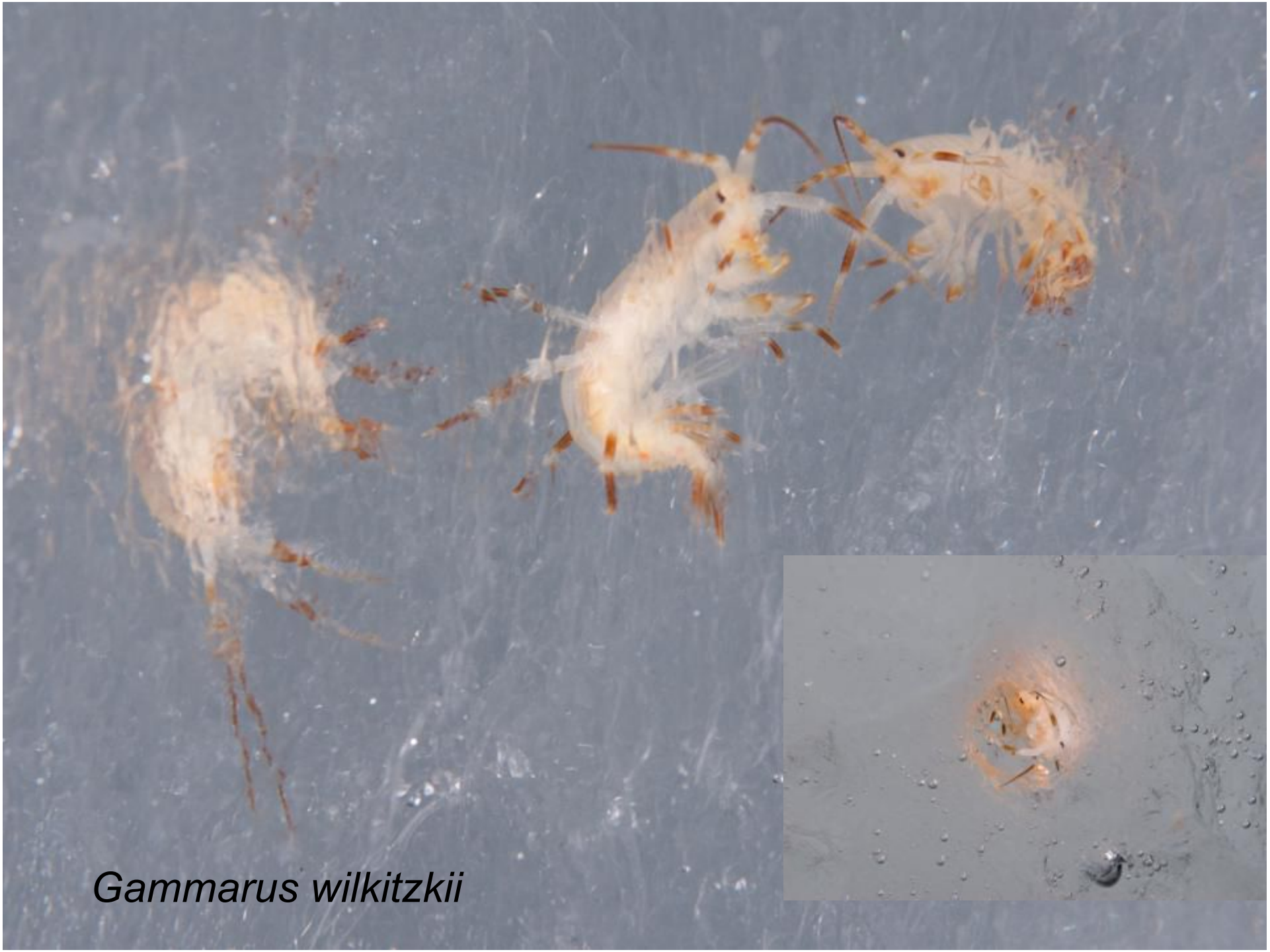
Daase *et al.* (2013)



Kosobokova & Hirche (2009)



Hunt *et al.* (in prep.)


Gammarus wilkitzkii

Floating Ice-Algal Aggregates below Melting Arctic Sea Ice

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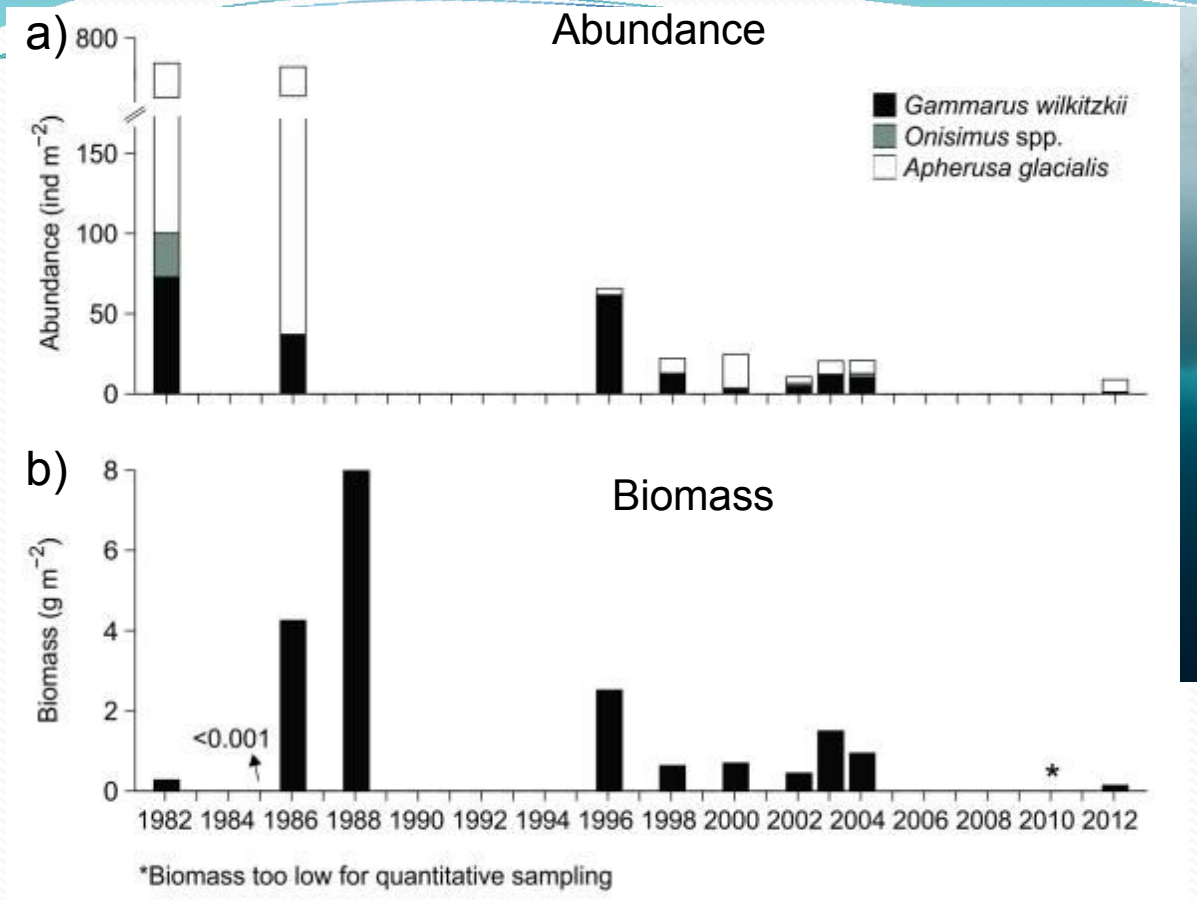
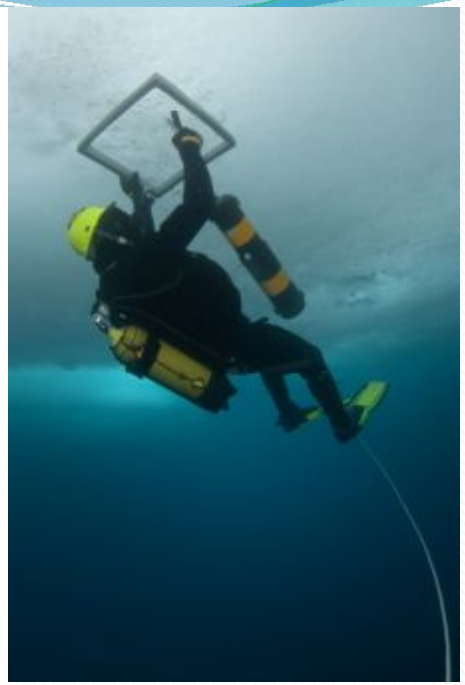
PLoS One 2013, 8 (10)





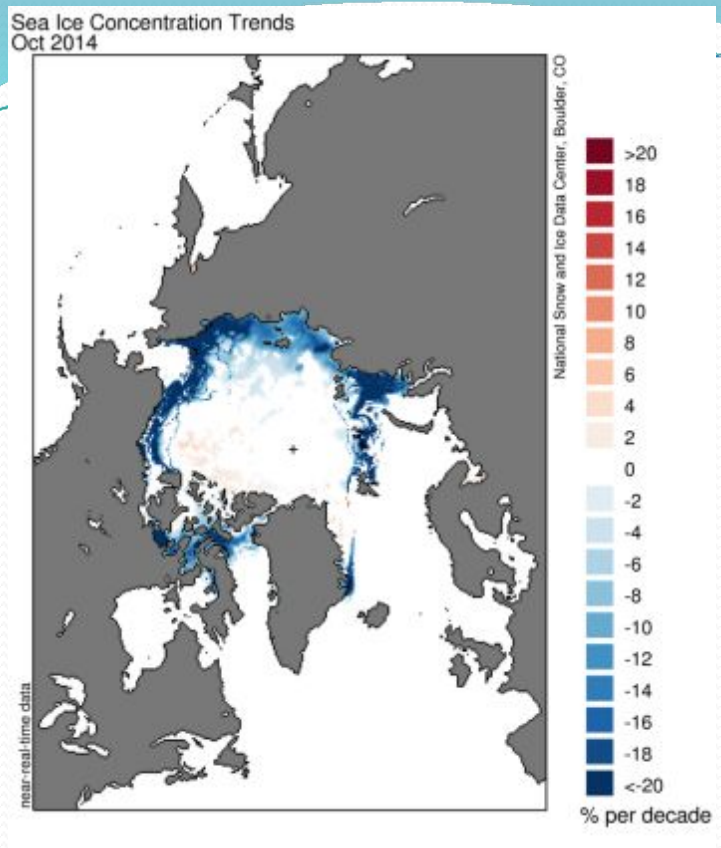
Abundance (ind.$^{-2}$) estimates of the most common ice amphipod species **(a)**, and estimates of biomass (wet weight, g m^{-2}, for all three species combined) between July and September in sea ice north of Svalbard (>79 °N) **(b)**.

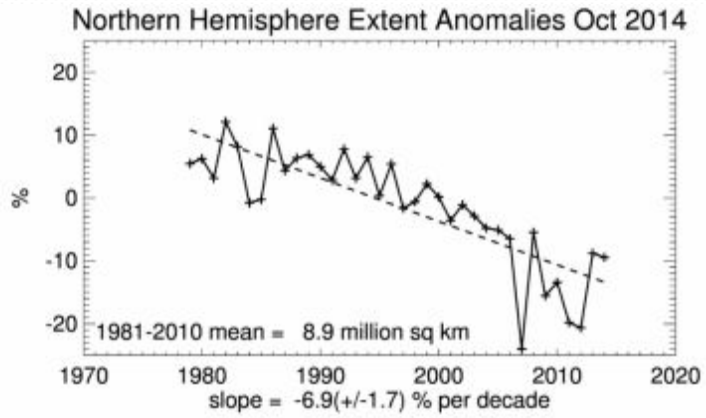
Sympagic (cryopelagic) fauna

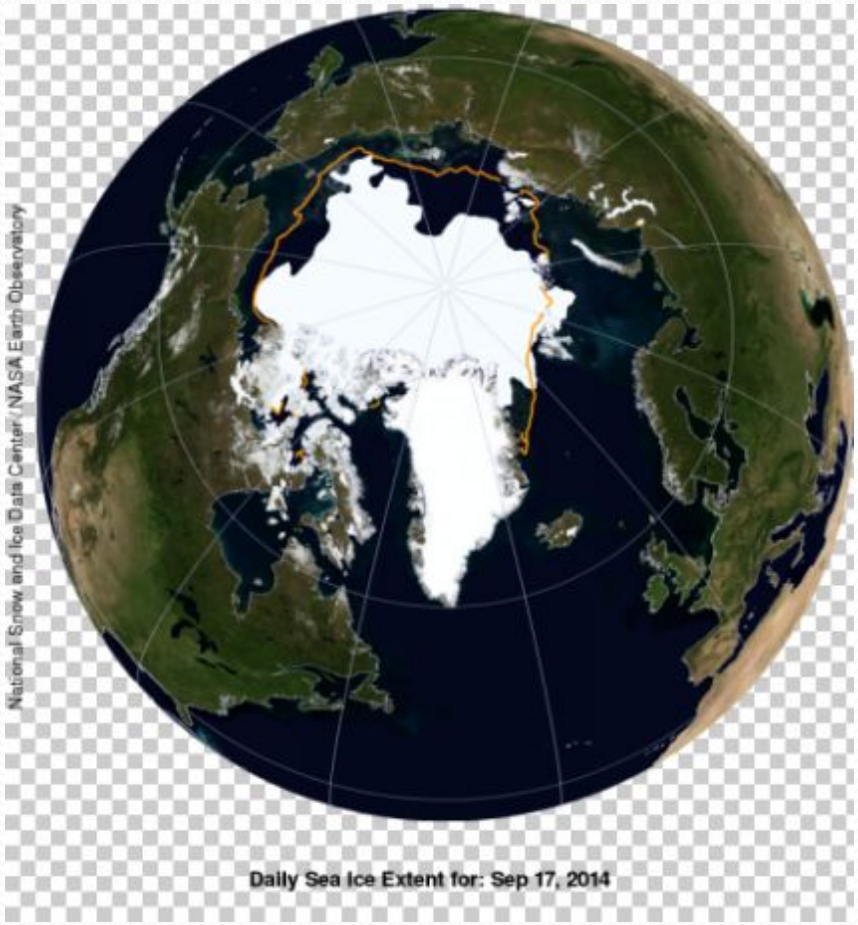
NP-22, 23 1977-1980	Taxon	PAICEX 2007-2011
1	Foraminifera	0
1	Radiolaria	0
2	Pteropoda	0
1	Polychaeta	0
18	Copepoda	11
1	Ostracoda	1
1	Mysidaceae	0
2	Isopoda	0
14	Amphipoda	2
1	Chaetognatha	1
1	Appendicularia	1
1	Decapoda	0
Total: 48		**Total: 16**

Igor Melnikov, unpubl. data

Arctic sea ice extent, Sept-Oct. 2014







NSIDC/NASA Earth Observatory

Conclusions

•Changes in the physical factors varied amongst regions, and showed direct effects on organisms linked to sea ice.

•Since life history traits of key herbivores in the system are adapted to utilize both ice algae and phytoplankton as a food sources, there is a potential for mis-match where ice disappears earlier in the season, given that the relative timing of ice algae and phytoplankton blooms may change.

•Sea ice-derived organic matter continues to be an important early food source for sympagic (ice-associated), pelagic and benthic biota in the Arctic.

•Sea ice habitats appear to be undergoing change with regard to availability and suitability for associated biota during their entire life cycles, as indicated by regional declines in their diversity, abundance and biomass.

•The rather dramatic reductions in sea-ice extent are expected to cause cascading effects in the ice-associated ecosystem.

•Monitoring and modelling efforts will be important to document and predict changes related to diminishing sea ice.

N-ICE2015

Thanks for your attention!